Appendix G

Details of TREGRO Parameterization

Basswood - Parameterization Procedure

A TREGRO parameter set for basswood was developed to simulate the growth of the species at Shenandoah National Park. At present, no ozone response has been documented for the species, but based on personal communication with Howard Neufeld at Appalachian State University, it is most likely intermediate in sensitivity, along the lines of red maple. The parameter set is called Basswood and the allometry is contained in an Excel spreadsheet titled basswood allometry.

Initial tree biomass

Estimates of initial tree biomass were generated from the allometry of Ter-Mikaelian and Korzukhin (1997). Trees of 30 and 31.2 cm dbh were estimated based on measurements of Abrams et al. (1998). No allometry was available for roots, so a root to shoot ratio of 0.35 was assumed. Of the root mass, 60 percent was assigned to coarse roots (divided equally between a and b1) and 40 percent assigned to fine roots (divided equally between a, b1, and b2). Similarly, no detail was available to partition wood, structure, and TNC so 70 percent of branch, stem, and coarse root mass was assigned to wood. The remaining 30 percent was divided between structure (70 percent) and TNC (30 percent), thus 21 percent was structure and 9 percent was TNC.

Seasonal phenology

Seasonal phenology was based on estimates supplied by Christi Gordon, US NPS, Shenandoah National Park, based on her conversations with Park Naturalists.

Carbon assimilation

Net carbon assimilation on a high light (1000 μE m^{-2} s^{-1}; 25 - 30 ˚C), midsummer (DoY 200-210) period was set to approximately 0.0086 g carbon g^{-1} leaf carbon hr^{-1} based on values reported by Abrams et al. (1994). No measurements of respiration were available.

Final tree biomass

The target was to grow a basswood tree based on three years of meteorological data from Big Meadows, Virginia. The final TREGRO simulated tree was calibrated by adjusting tissue growth rates and senescence rates in fine roots until two conditions were met: (1) the simulated C gain of each of the tree components, foliage, branch, stem, and coarse and fine roots, and the total tree C gain were within 10 percent of the value for projected C gain from the literature-based allometric relationships and (2) when the proportion of TNC, structure, and wood in each of the tree components at the end of a simulation matched that parameterized for the tree at the beginning of the simulation (see Basswood allometry spreadsheet).

Basswood Literature Citations:

Abrams, M. D., M. E. Kubiske, and S. A. Mostoller. 1994. Relating wet and dry year ecophysiology to leaf structure in contrasting temperate tree species. Ecology 75: 123-133.

Abrams, M. D., C, M. Ruffner, and T. E. DeMeo. 1998. Dendroecology and species co-existence in an old-growth *Quercus-Acer-Tilia* talus slope forest in the central Appalachians, USA. For. Ecol. Mgmt. 106: 9-18.

Ter-Mikaelian, M. T. and M. D. Korzukhin. 1997. Biomass equations for sixty-five North American tree species. For. Ecol. Mgmt. 97: 1-24

Chestnut Oak - Parameterization Procedure

A TREGRO parameter set for chestnut oak was developed to simulate the growth of the species at Shenandoah National Park. At present, no ozone response has been documented for the species. It might be assumed to be similar in response to red oak. The parameter set is called ChestnutOak and the allometry is contained in an Excel spreadsheet titled chestnut oak allometry.

Initial tree biomass

Estimates of initial tree biomass were generated from the allometry of Martin et al. (1998). Trees of 30 and 31.008 cm dbh were estimated based on measurements of Rauscher and Smith (1979). No allometry was available for roots, so a root to shoot ratio of 0.35 was assumed. Of the root mass, 60 percent was assigned to coarse roots (divided equally between a and b1) and 40 percent assigned to fine roots (divided equally between a, b1, and b2). Similarly, no detail was available to partition wood, structure, and TNC so 70 percent of branch, stem, and coarse root mass was assigned to wood. The remaining 30 percent was divided between structure (70 percent) and TNC (30 percent), thus 21 percent was structure and 9 percent was TNC.

Seasonal phenology

Seasonal phenology was based on estimates supplied by Christi Gordon, US NPS, Shenandoah National Park, based on her conversations with Park Naturalists.

Carbon assimilation

Net carbon assimilation on a high light (1000 μE m^{-2} s^{-1}; 25 - 30 ˚C), midsummer (DoY 200-210) period was set to approximately 0.026 g carbon g^{-1} leaf carbon hr^{-1} based on values reported by Sullivan et al. (1996). No measurements of respiration were available.

Final tree biomass

The target was to grow a chestnut oak tree based on three years of meteorological data from Big Meadows, Virginia. The final TREGRO simulated tree was calibrated by adjusting tissue growth rates and senescence rates in fine roots until two conditions were met: (1) the simulated C gain of each of the tree components, foliage, branch, stem, and coarse and fine roots, and the total tree C gain were within 10 percent of the value for projected C gain from the literature-based allometric relationships and (2) when the proportion of TNC, structure, and wood in each of the tree components at the end of a simulation matched that parameterized for the tree at the beginning of the simulation (see Chestnut Oak allometry spreadsheet).

Chestnut Oak Literature Citations:
Martin, J. G., B. D. Kloeppel, T. L. Schaefer, D. L. Kimbler, and S. G. McNulty. 1998. Aboveground biomass and nitrogen allocation of ten deciduous southern Appalachian tree species. Can. J. For. Res. 28:1648-1659.

Rauscher, H. M. and D. W. Smith. 1979. Predicting daily radial growth of chestnut oak and pitch pine on a dry mountain site. For. Sci. 25: 233-236.

Sullivan, N. H., P. V. Bolstad, and J. M. Vose. 1996. Estimates of net photosynthetic parameters for twelve tree species in mature forests of the southern Appalachians. Tree Phys. 16: 397-406.

White Ash - Parameterization Procedure

A TREGRO parameter set for white ash was developed to simulate the growth of the species at Shenandoah National Park. The ozone dose-response is not set at this time. The parameter set is called Whiteash and the allometry is contained in an Excel spreadsheet titled white ash allometry.

Initial tree biomass

Estimates of initial tree biomass were generated from the allometry of Ter-Mikaelian and Korzukhin (1997). Trees of 30 and 32.5 cm dbh were estimated based on measurements of Abrams et al. (1994, 1997). No allometry was available for roots, so a root to shoot ratio of 0.35 was assumed. Of the root mass, 60 percent was assigned to coarse roots (divided equally between a and b1) and 40 percent assigned to fine roots (divided equally between a, b1, and b2). Similarly, no detail was available to partition wood, structure, and TNC so 70 percent of branch, stem, and coarse root mass was assigned to wood. The remaining 30 percent was divided between structure (70 percent) and TNC (30 percent), thus 21 percent was structure and 9 percent was TNC.

Seasonal phenology

Seasonal phenology was based on estimates supplied by Christi Gordon, US NPS, Shenandoah National Park, based on her conversations with Park Naturalists.

Carbon assimilation

Net carbon assimilation on a high light (1000 μE m^{-2} s^{-1}; 25 - 30 ˚C), midsummer (DoY 200-210) period was set to approximately 0.013 g carbon g^{-1} leaf carbon hr^{-1} based on values reported by Kubiske et al. (1996). No measurements of respiration were available.

Final tree biomass

The target was to grow a white ash tree based on three years of meteorological data from Big Meadows, Virginia. The final TREGRO simulated tree was calibrated by adjusting tissue growth rates and senescence rates in fine roots until two conditions were met: (1) the simulated C gain of each of the tree components, foliage, branch, stem, and coarse and fine roots, and the total tree C gain were within 10 percent of the value for projected C gain from the literature-based allometric relationships and (2) when the proportion of TNC, structure, and wood in each of the tree components at the end of a simulation matched that parameterized for the tree at the beginning of the simulation (see white ash allometry spreadsheet).

White Ash Literature Citations:

Abrams, M. D., M. E. Kubiske, and S. A. Mostoller. 1994. Relating wet and dry year ecophysiology to leaf structure in contrasting temperate tree species. Ecology 75: 123-133.

Abrams, M. D., D. A. Orwig, and M. J. Dockry. 1997. Dendroecology and successional status of two contrasting old-growth oak forests in the Blue Ridge Mountains, U. S. A. Can. J. For. Res. 27: 994-1002.

Kubiske, M. E., M. D. Abrams, and S. A. Mostoller. 1996. Stomatal and nonstomatal limitations of photosynthesis in relation to the drought and shade tolerance of tree species in open and understory environments. Trees (Berlin) 11: 76-82.

Ter-Mikaelian, M. T. and M. D. Korzukhin. 1997. Biomass equations for sixty-five North American tree species. For. Ecol. Mgmt. 97: 1-24